Using elemental concentrations and dust loadings as metrics of human exposure to potentially toxic elements in kindergarten indoor dust

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Abstract

Due to the hand-to-mouth activities frequently observed among the youngest children, they are likely to ingest higher amounts of indoor dust than adults. Since pre-schoolers are prone to exposure to potentially toxic elements (PTEs) through the ingestion route, characterizing human exposure within kindergarten microenvironments is paramount for children who spend considerable time in school. Ergo, a study encompassing five kindergartens in the industrial city of Estarreja was performed. Indoor dust samples were collected from the kindergartens. The present study reports dust metal(loid) concentrations and metal(loid) loadings to estimate indoor exposure to PTEs. Dust metal(loid) loadings are expressed in units of μg m^{-2}. Total concentrations of chromium (Cr), cobalt (Co), nickel (Ni), cadmium (Cd), arsenic (As), and lead (Pb) were determined by Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) in the <63 μm and <250 μm particle size fractions of the indoor dust. The results show that the elemental loadings vary widely among the different kindergartens but are consistently higher in the finer dust size fraction. Non-parametric analysis (Spearman's rank-order correlation) shows strong and significant ($p<0.001$) positive correlations between dust loading - dust elemental loading. Relatively strong correlations were also obtained between elemental loadings and elemental concentrations, but the relationship is only significant for Ni and Pb. The strong correlation ($r_s = 0.73$) between Pb concentration and dust Pb loading suggests that dust loading, ranging from 54.6 to 978.7 mg m^{-2} in the coarse fraction and 5.0 to 161.2 mg m^{-2} in the finer particle size fraction, has a greater influence on dust Pb loading. The results suggest a negligible influence of dust mass over the dust elemental loading for elements such as Cd, Co, Cr and As.

Keywords: Elemental dust loading; Particle size; Lead, data analysis; Portugal

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